SOME PLANT-LICE AFFECTING PEAS, CLOVER, AND LETTUCE.*

BY E. DWIGHT SANDERSON.

Nectarophora pisi, Kalt., and varieties.

The "Green Dolphin" is one of the best-known pests of peas and vetches in Europe, though but little concerning its economy has been recorded by European writers. In this country, *N. pisi*, Kalt., has been noted by Thomas[1], Oestlund[2], and Williams[3], but as their specimens were never compared with any from Europe, and as plant-lice are exceedingly variable and descriptions of them are, therefore, often of but little value even when accurate, the identity of their specimens with the European forms has been somewhat in doubt.

At the beginning of the present outbreak of the pest in the spring of 1899, as specimens of *N. pisi* of both American and European authors were unavailable for comparison, and as most of the European writers described the species as very much smaller than the remarkably large form under consideration, the species was named *Nectarophora destructor* by Prof. W. G. Johnson[4], and described by him as new[5]. Prof. Johnson gives[4] Mr. Th. Pergande as authority for the species, stating that he "considers it an undescribed species," and adds, "Inasmuch as Mr. Pergande does not care to describe it, it is my privilege to name the insect."

In Dec., 1899, the attention of the writer was called to a species of *Nectarophora* doing serious injury to lettuce under glass. Careful study failed to reveal but a few minor characteristics by which this species could be separated from *N. destructor*, Johns., the chief difference being its smaller size, but many specimens were as large as small *destructor*. The similarity of this aphid to *destructor* led to a study of the plant-lice infesting lettuce foliage, and also of the variation in size, form and colour of *N. destructor*, taken at different times during 1899 and 1900. The following table gives the average measurements of different series of specimens of *destructor*, those of *N. pisi*, Kalt., as given by various authors, and those of *N. destructor* as described by Prof. Johnson. Numbers 3, 4, 5, 11, 17, 20, 21 and 22 are all unquestionably *N. destructor*, Johns.:

(*From the Entomological Dept. of the Delaware College Agricultural Experiment Station, Newark, Del.)

1 Thomas, 8th Rept. St. Ent., Ill., p. 64 (1879).
2 Oestlund, Bull. No. 4, Geol. and Nat. Hist. Surv., Minn., p. 82 (1887).
3 Williams, Spec. Bull. No. 1, Univ. Nebr., Dept. Ent., pp. 6, 9, 18, 20, 23 (1891).
4 W. G. Johnson, Bull. No. 20, n. s., Div. Ent., U. S. Dept. Ag., pp. 94-9 (1899).
5 W. G. Johnson, CANADIAN ENTOMOLOGIST, XXXII., pp. 55-60 (Feb., 1900).

Nectarophora pisi, Kalt., and varieties.

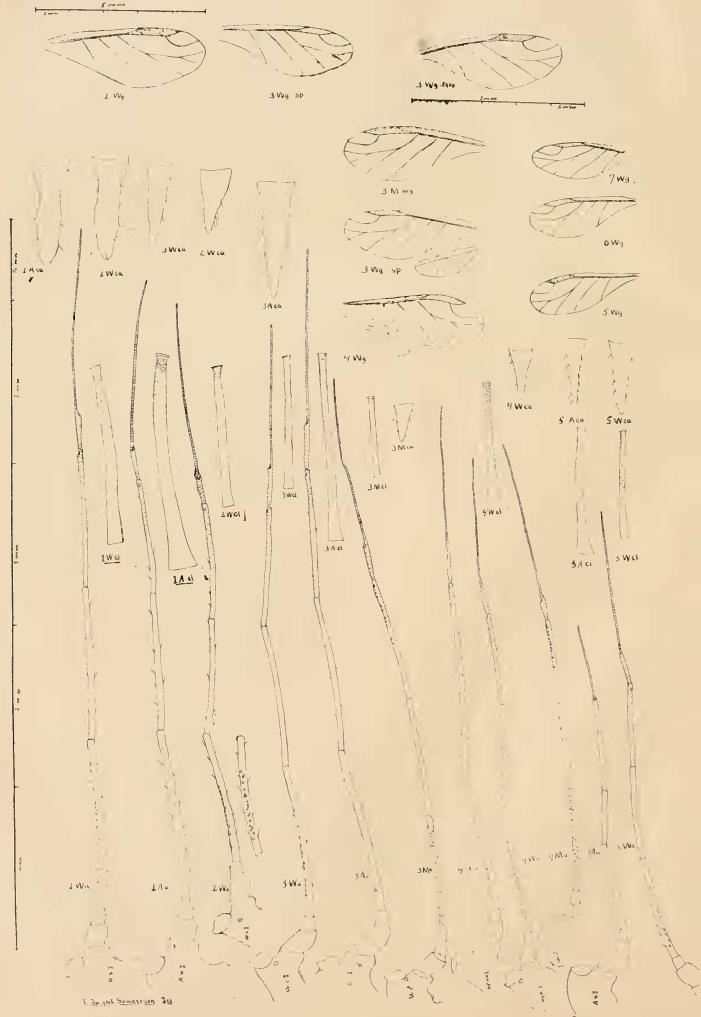
(Measurements in 1-100 millimeters.)

No.	Description.	Date.	No. Specns	Wing Exp.	Length.	Width.	Antennæ. A. L'gth.	III.	IV.	V.	VI.	VII.	Tibia. T. I.	II.	III.	Cauda.	Cornicles.
					L.	W.										ca.	cl.
	Winged Viviparous Female.																
1	From G. B. Buckton	June 17, -47	1	1100	410	160	450	140	103	84	21	114	200	200	263	63	114
2	N. destructor, Johns.....	CAN. ENT. Feb., 1900		1100	400–500	100–115	525 (+30)	150	100	75	50	150				½ cl.	100–115
3	Newark, Del., on pea....	Nov. 1, 1899	1	1000	300	116	430	100	100	82	35	112	200	200	250	46	82
4	" "	Oct. 26, 1899	5	1000	320	110	434	94	87	82	30	113	182	180	240	48	86
5	" "	Oct. 10, 1900 Spring 1900, 1892	6	1000	345	115	427	95	90	83	30	116	181	186	255	49	86
6	Kaltenbach	1843			250–300												
7	Koch*.....	1859		900	330	120	350	90	60	50		110	120	130	150	35	80
8	Oestlund.....	1887					(395)	90	75	70	20	110				45	90
9	Buckton.....	1875		914–964	227	88	381										101
10	From G. B. Buckton.....		2		270	114	385	78	76	68	21	120	183	183	240	40	92
11	Newark, Del., on pea....	Nov. 17, 1900	13	930	314	105	390	88	81	72	28	97	162	162	225	42	70
12	Lexington, Ky., on lettuce	Feb., 1895	4		315	105	360	87	71	68	20	102	160	170	221	30	83
13	Newark, Del., on lettuce.	Dec., 1899	3	900	230	80	340	93	75	59	14	90	150	150	200	30	70
14	Balto. Co., Md., on lettuce	Feb., 1899	2	700–800	235	85	313	82	61	56	14	100	145	145	185	33	71
15	Milford, Del., on pea	May 1, 1900	7	700	216	85	300	75	54	52	17	82	133	133	180	30	60
16	Iowa Agr. Coll., clover ..	Oct. 15, 1891	1		230	90	300	64	54	56	20	86	120		170	40	65

	Winged Male.																
17	Newark, Del., pea.....	Nov. 17, 1900	3	900	250	95	362	77	71	73	23	102	157	150	190	24	50
17*a*	Newark, Del., lettuce....	Dec., 1899	1	750	200	75	300	63	65	52	14	111	132	135	165	16	42
	Apterous Viviparous Female.																
18	From G. B. Buckton	June 17, -47	2		400	160	440	110	86	80	22	112	195	205	271	66	132
		CAN. ENT.			400	100										(50	125
19	N. destructor, Johns.....	Feb., 1900			-600	-200	Longer		than		winged.					-70) +	-200
		Oct., 1899															
20	Newark, Del., on pea....	" 1900	13		320	115	450	112	92	80	28	108	191	187	274	66	113
21	Milford, Del., on pea	May 1, 1900	10		339	159	451	111	91	80	294	107	186	185	270	70	110
22	Newark, Del., on clover .	May, 1892															
					250												
23	Kaltenbach	1843			-400												
24	Koch*.	1859			320	130	350	80	60	50		110	120	120	150	20+	80
25	Taschenberg.....	1871			400												
26	Lexington, Ky., lettuce ..	Feb. 23, 1895	4		300			92	69	58	15	93	155	155	225	41	75
27	Newark, Del., lettuce....	Dec., 1899	4		300	130	355	90	60	56	17	100	163	170	210	42	90
28	Iowa Agr. Coll., clover ..	April 17, 1893	2		300	137	215	57	35	38	21	43	89	95	135	43	74
29	Buckton.....	1875			270	127	355										88

* Measured from figure—probably inaccurate. ( ) Partly computed by writer.

CAN. ENT., VOL. XXXIII. PLATE 2.



This study showed that the measurements given in the description of the species by Prof. Johnson represented specimens in May and June, when the species is at its maximum size, but specimens much smaller were found at that season, and those collected in October of 1899 and 1900 were uniformly smaller. It was found that the average size of specimens measured was as near that of *N. pisi*, Kalt., of Oestlund, as *N. destructor*, Johns., with no marked difference in colour. A careful review of European literature showed the size of *N. pisi*, Kalt., as given by different writers, to be quite variable; the length, for instance, as given by Koch (No. 7) is 3.3 mm., while Buckton (No. 9) gives 2.27 mm., and Taschenberg states that the winged female is slightly shorter than the wingless (No. 25), which he describes as 4 mm. long. The coloration as given by these writers is also variable.

In October, 1900, a form of the winged female (No. 11)—described below—was found migrating from peas to clover, which was much darker and smaller than the summer broods and in many respects more similar to some of the descriptions of *N. pisi*, and at the same time the apterous females and nymphs were distinctly pulverulent, which was not observed in June, but is mentioned in descriptions of *pisi*. A few winged males (No. 17)—described below—were also secured.

Having become well convinced of the identity of the two species, specimens of *N. pisi*, Kalt., were secured from Mr. G. B. Buckton, F.R.S., Haslemere, Eng., who kindly lent me two slides containing several specimens in Canada balsam. The specimens of one slide, collected at "Southgate, June 17, -47" (1847?) (Nos. 1 and 18), were of exactly the same size as *N. destructor* as described by Prof. Johnson, with exception of segment VI. of the antennæ being very much shorter. They also differed in having the cornicles and antennæ (Pl. I., 1a., 1cl.) considerably thicker than the smaller specimens of *destructor*, though very probably this is largely due to their having been flattened by the pressure of the cover glass and the drying of the balsam. The surface of the tips of the cornicles is reticulated, which has not been observed in typical *destructor*. None of these differences can, however, be considered as of sufficient value to separate the species, especially when one considers the variability of the species as given by European writers. The specimens of the other slide, marked by Mr. Buckton, "*Siphonophora pisi*?—Fool's Parsley," are considerably smaller, but are similar to the smaller forms of *destructor* found here, and lack the reticulation on the cornicles. There

is little question, therefore, but that the species (*N. destructor*, Johns.) so injurious during the past two seasons is the well-known "Green Dolphin" (*N. pisi*, Kalt.) of Europe[6].

Past History.—In Europe the "Green Dolphin" has been known as one of the worst pests of peas and vetches for over a century. Kirby and Spence, writing in 1815, give an account of the damage done by this pest which corresponds very closely with our own experience, "those (aphids) which attack pulse spread so rapidly, and take such entire possession, that the crop is greatly injured, and sometimes destroyed by them. This was the case in 1810, when the produce was not much more than the seed sown; and many farmers turned swine into the pea fields, not thinking them worth harvesting. The damage in this instance was caused solely by the aphis, and was universal throughout the kingdom so that a supply for the navy could not be obtained. The earlier peas are sown, the better chance they stand of escaping, at least in part, the effects of this vegetable Phthiriasis." It is also remarked that the pest is worse in dry seasons.

The insect is evidently either native to America or has been established here for many years. The first record of its occurrence was in Minnesota in 1887 on Shepherd's Purse[7]. Since then it has been noted in Nebraska and Illinois on clover, beets, peas, and other plants.

Early in May, 1890, an experimental plot of crimson clover at this station was so badly attacked by what was undoubtedly this species of aphid that for a time it was feared the experiment would prove a failure.

One or two extensive growers of crimson clover inform me that they have seen this pest on crimson clover for at least six or seven years. As no other aphid is known to attack clover in any considerable numbers, there seems to be little doubt but that the same species has been present in Delaware for at least ten years. Mr. F. A. Sirrine writes me that Long Island pea growers state that "they had a similar trouble with their

6 The full bibliography of the species appears in the Report of the Del. Coll. Ag. Exp. Sta. for 1900. *Aphis ulmariæ*, Schrank, is undoubtedly the same species and several writers have preferred to use that name. Schrank's description, however, is not clearly recognizable, and I have preferred, therefore, to follow the majority of writers in using Kaltenbach's name. Exception might be taken to this usage, as very many aphids are not to be recognized from the original description of the species, but where types are not extant for purposes of comparison it would be much better were such descriptions discarded.

7 Thomas mentions it in Illinois in 1879, but it is doubtful whether his description applies to this species.

peas eight or ten years ago." In 1887 an aphid very similar to this species, and probably the same, was observed by Dr. L. O. Howard, U. S. Entomologist, on clover at Washington, D. C. Mr. R. H. Pettit, of the Mich. Agl. Experiment Station, informs me that one or two Michigan pea growers state that they have known a similiar plant-louse to infest peas for the past twenty years.

Fall Migratory Winged Viviparous Female.—Wing expanse, 9.3 mm. Length, 3.15 mm.; width, 1.05 mm.; Antennæ, 3.9 mm., III., 0.88 mm.; IV., 0.81 mm.; V., 0.72 mm.; VI., 0.28 mm.; VII., 0.97 mm. Tibia, I., 1.62 mm., II., 1.62 mm., III., 2.25 mm.; Cauda, 0.42 mm.; Cornicles, 0.70 mm. Average of 13 specimens.

Coloration same as male, except chitinous plates are slightly lighter, lateral spots and those above spiracles in abdomen are wanting, with two dark spots on subgenital plate, subventral plate green, lacking sensoria on V. antennal segment.

Apterous Viviparous Female.

Specimens late in October and in November are more or less covered with a distinct whitish pulverulence, are smaller, and darker green than in the summer.

Larvæ of these same broods have antennæ, cornicles and legs blackish or dark brown, body with more or less whitish pulverulence, which is especially marked and distinct on distal half of hind tibia; very different from larvæ in spring or summer.

Winged Male.—Wing expanse, 9 mm.; Length, 2.5 mm.; width, 0.95 mm.; Antennæ, 3.62 mm.; III., 0.77 mm.; IV., 0.71 mm.; V., 0.73 mm.; VI., 0.23 mm.; VII., 1.02 mm.; Tibia, I., 1.57 mm.; II., 1.50 mm.; III., 1.90 mm.; Cauda, 0.24 mm.; Cornicles, 0 50 mm. Average of 3 specimens.

Dorsal aspect head yellowish, ocelli black, eyes red, mesal line darker, a dark spot either side of meson caudally; ventral aspect head and thorax yellow, except mesosternum which is deep olive brown to blackish, shining, chitinous; rostrum reaches to centre of mesosternum, prothorax dorsally yellowish-green, thoracic dorsal plates dark-olivaceous to blackish; legs yellowish or reddish brown, tips of femora and tibia, and tarsi black; large blackish pleural spot on either side of mesothorax and two smaller spots caudad of it at bases of mesa and meta coxæ; abdomen light green, slightly whitish pulverulent, three or four lateral blackish spots cephalad of cornicles; cornicles green, tips black; cauda green;

irregular horizontal spots on either side of abdomen around pores of connexivum above spiracles.

VARIETIES.

Specimens of *Nectarophora*, on lettuce: collected at Lexington, Ky., in Feb., 1895 (Nos. 12, 26), kindly loaned me by Prof. H. Garman; on lettuce in Baltimore County, Md., Feb., 1899 (No. 14), by Prof. W. G. Johnson; and on clover at Ames, Iowa (Nos. 16, 28), by Mr. F. A. Sirrine; have all been carefully studied and measured. A similar form was also taken at Milford, Del., on peas, May 1, 1900.

The dimensions of series of these aphids, as given in the table, shade into each other and *N. destructor* and *pisi* so as to make it impossible to separate them satisfactorily on any distinctions of size. It should be remembered that the measurements of the table merely give the average size of each series and that individual specimens vary widely from them. Numbers 12, 13, 14, 15, 26 and 27 are of the same variety. They may be distinguished by segment III. of the antennæ of the apterous viviparous females bearing six to eight sensoria, about half of which are much larger than the remainder, while *N. pisi* has but one; the tips of the cornicles in both winged and wingless are reticulated as in No. 1 *N. pisi* from England, whereas in American forms of *N. pisi* (*N. destructor*) they are plain. A single winged male, seemingly of this species, was taken on lettuce at Newark, in Dec., 1899. It (No. 17a) is similar to the male of *pisi*, except that it is smaller and IV. has two sensoria, which are lacking in *pisi*, the sensoria on III. and V. being similar.

The winged (No. 16) and apterous (No. 28) viviparous females from Iowa lack the reticulation on the cornicles, and the sensoria are as in *N. pisi*, though they are so much smaller that they are probably a distinct variety. The apterous forms from Iowa (No. 28) are "stem mothers," having been hatched from winter eggs. They differ from the other apterous forms in the shorter antennæ and legs, and in VII. being shorter than III. It is not unusual, however, for the stem mother to differ from other broods. No distinctive characters could be found in the wing venation of any of these specimens.

For the present, therefore, from the material studied, we are obliged to consider all of these specimens as varieties of *N. pisi*, Kalt. A larger series and further observation of their life-histories may reveal specific distinctions. The present account is published merely to show the extreme

variability of this species (or, as it may prove to be, the likeness of several species), and the necessity of a careful study of it and allied species. The writer will be greatly indebted to any who may be able to aid him with material, preferably alive, for the prosecution of such a study.

Thomas's *S. pisi* (l. c.) does not seem to be the same as *N. destructor*, but is quite similar to the varieties described above.

N. erigeronensis, Thos., and *N. corydalis*, Oest., are very closely allied to *N. pisi*, but specimens of them have not come under our observation.* The types of neither seem to have been preserved.

(To be continued.)

*ADDENDA.—Since writing the above, Mr. O. W. Oestlund has kindly sent me specimens of these species. Concerning them he remarks:

"1. *N. erigeronensis* is well separated from *pisi* and *corydalis* by having the sensoria more numerous and scattered in several rows along the whole length of joint III., and by being raised above the surface or forming distinct protuberances. Front femur much shorter (0.70 mm.). Front wings shorter. Spur (VII.) of antenna equal to or not much longer than III.

"2. *N. pisi* is a much larger form. Sensoria less numerous (15–18) and nearly in a single row, and almost absent on apical ⅓ of segment; not forming protuberances. Front femur much longer. Front wings larger. Spur much longer than III. (1.20 :: 0.90).

"3. *N. corydalis* comes very close to *pisi*, and possibly too close to stand, though in the general aspect of the insect it seems quite distinct. Size smaller. Sensoria fewer in number (12–15) and in a single row. Front femur, front wings, and spur much as in *pisi*."

The specimens sent me measured as follows:

Form.	Description.	Date.	No.	Wing Exp.	L.	W.	Antennæ.							Tibia.			Ca.	Cl.
							L.	III.	IV.	V.	VI.	VII.		I.	II.	III.		
W. V. Female	N. pisi	Oct. 28, '00	3	850	270	90		80						150		210	32	85
A. V. Female.	"	"	3		295	100		89	70					155	160	225	42	95
W. V. Female	N. corydalis	Sep. 26, '85	4	800	208	85	290	65	57	60	15	88		130	130	190	34	64
W. V. Female	N. erigeronensis	June 27, '98	3	750	220	80	200	55	38	35	12	48		83	96	130	31	66
A. V. Female.	"	"	5		200		205	55	36	33	13	53		85	85	127	30	76

All were collected at Minneapolis, Minn.

This *N. pisi* is similar to Nos. 12, 13, etc. above, taken on lettuce, and shows the same differences between it and var. *destructor*. The specimens were collected on squash. The apterous viviparous female has 5 to 8 sensoria on III.

N. corydalis seems similar to No. 15 above. It does not differ materially from Oestlund's *pisi* (as he remarks), and I think it merely a variation, possibly a distinct variety.

N. erigeronensis is a quite distinct species. In the apterous viviparous female the cornicles are thicker, more finely reticulated at apex than in *pisi*, are blackish, reach beyond the cauda, curving outward; antennæ dark, 9 to 15 sensoria on proximal half of III. In the winged viviparous female the antennæ, tibiæ, distal half of femora, apical ⅔ of cornicles are blackish, cornicles reach to tip of cauda; sensoria numerous (20 or so) on III., and protuberant; capitate hairs scattering on antennæ and body. E. D. S.